

Characterization of Arctic Treelines by LiDAR and Multispectral Imagery

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The position and dynamics of the forest-tundra boundary are major determinants for land atmosphere interactions at the circumpolar scale and for ecological and socioeconomic purposes at the local to regional scale. However, our understanding of the location, dynamics and environmental drivers (natural and human factors) at regional and circumpolar level is currently poor. The project 'Present day processes, Past changes, and Spatiotemporal variability of biotic, abiotic and socio-environmental conditions and resource components along and across the Arctic delimitation zone' ('PPS Arctic') is a core activity of the International Polar Year (IPY), and it has identified the characterisation and representation of the arctic treeline as a major priority that will necessarily make extensive use of remotely sensed data.

There are a number of methodological difficulties associated with circumarctic mapping of the treeline, related principally to spatial scale. While ecologists work, and define treelines, at a scale capable of resolving individual trees, imagery capable of providing the circumpolar perspective will have much coarser resolution. There is thus a requirement for preliminary research on scale relationships, as well as on optimum algorithms for discriminating forest from non-forest areas and for geometrically characterising treelines.

This paper describes some preliminary investigations to relate multispectral imagery to detailed geometrical characterisation of forest edge. Airborne data were acquired from two test sites in northern Norway in 2004 and 2005, using an Optech LiDAR, CASI and ATM imagers to give multispectral and geometrical representations at a spatial resolution of the order of 1 m. The data were used to characterise the forest geometry according to standard ecological definitions, and hence to identify the extent to which this geometry is represented in high-resolution airborne multispectral imagery. The imagery was then downscaled to simulate lower-resolution data such as from Landsat and MODIS.